

**State of Oregon
Department of Environmental Quality**

Memorandum

Date: May 17, 2012

To: Fredrick Moore – Oregon DEQ, Bend

From: Paul Seidel - Oregon DEQ, Eastern Region Toxicologist

Subject: ARCADIS's April 2012 report establishing Upper Prediction Limits for the Lockheed Martin Hazardous Waste Post-Closure Permit.

Fredrick, pursuant to your April 11, 2012 request for review of the referenced document, my comments are presented herein. In particular, I have focused on your questions concerning the adequacy of statistical power as demonstrated by power curves relative to EPA reference curves and comments number 17, 18 and 19 from U.S. EPA in the March 29, 2012 letter to you concerning EPA's review of the draft post-closure permit for this site.

EPA Comments

- 1) U.S EPA comment number 17 concerns the number of observations that should be used prior to performing statistical tests, and suggests that four observations may not be adequate for making statistical inferences. U.S. EPA recommends that quarterly sampling be conducted for two years. While not explicitly stated, this increased sampling frequency would presumably for the purpose of increasing the number of observations available for analysis over a shorter time frame. While this could be done to meet the U.S. EPA concern, I would suggest that it is not strictly necessary and that you consider negotiating this point with U.S. EPA. The rationale for why an increased monitoring frequency is not necessary is as follows:

In the comment U.S. EPA cites the unified guidance for analysis of groundwater at RCRA facilities. That document discusses 8-10 observations as a recommendation in Chapter 5 ("Establishing and updating background"), Chapter 7 (compliance Monitoring Strategies") and Chapter 8 ("Methods Summary"). It is worth noting that this recommendation is similar to other U.S. EPA guidance for 8-10 observations (the ProUCL software users guide) to make reliable estimates of mean concentrations. Moreover, I agree that 8-10 observations or more is a good idea. Generally, when the variability in data are unknown, 8-10 observations is a common recommendation to maximize the chances of reliable inferences can be made. However, when variability is understood and is low, inferences are possible with fewer samples, although this is less desirable from a statistical point of view. Because there is a long history of monitoring at this site, I would expect that the variability in site wells is well characterized and understood.

U.S. EPA in their comments and in the unified guidance makes the point that the observations should be independent. Independence is demonstrated by uncorrelated data. However, with environmental data sets, it is difficult, if not impossible to achieve truly independent data due to spatial or temporal correlations. EPA notes this point in the unified guidance which states *“Depending on site groundwater velocity, too-frequent sampling at any given background well can result in highly autocorrelated, non-independent data.”* Therefore, an increase in sampling frequency by decreasing the time between events runs the risk of auto-correlated non-independent data.

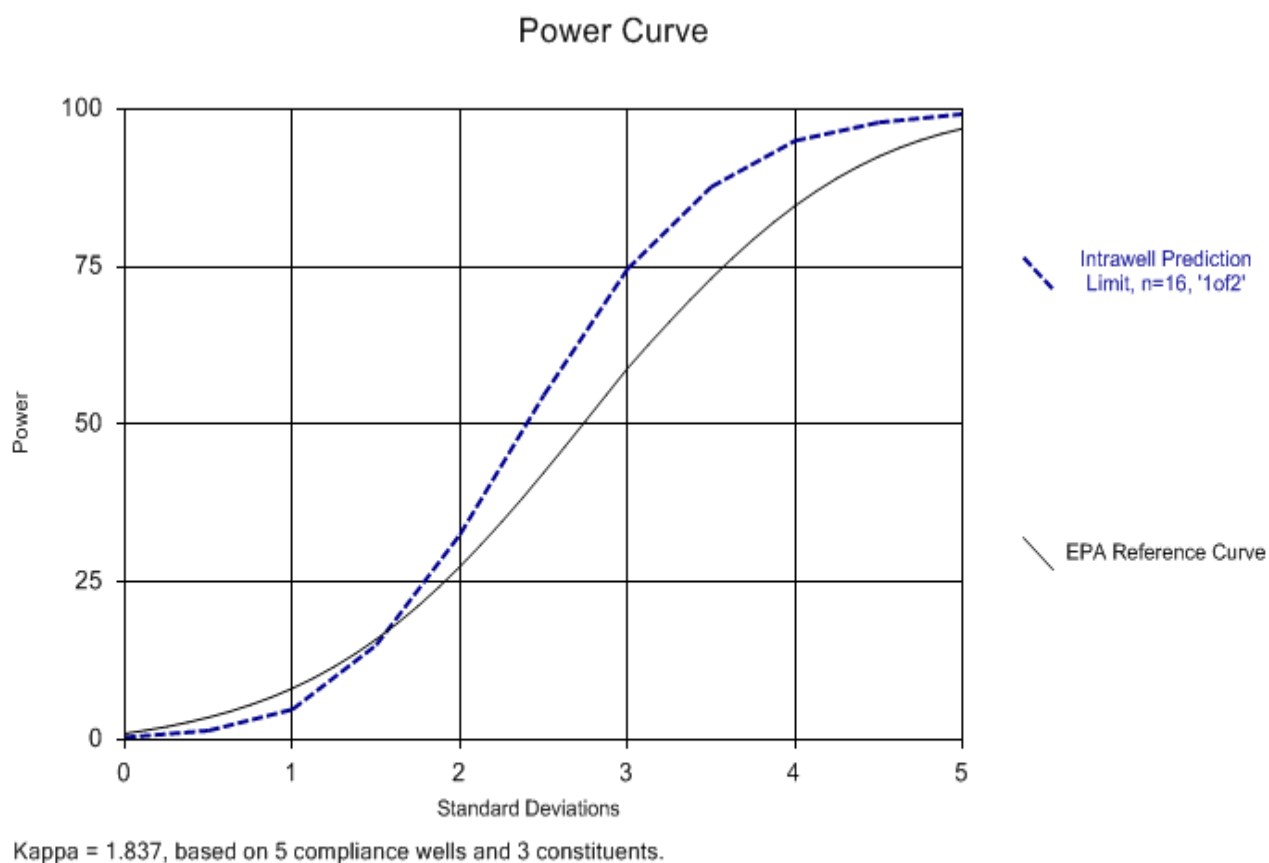
Because there is a long history at the site, the risk of an undetected leak at this stage would seem to be low, and the required additional data points to increase decision confidence will be accumulated over time. Therefore, it could be preferable to stay with the proposed sampling frequency reducing the risk of temporal autocorrelation, while confidence in conclusions will grow due to increased samples over time.

- 2) U.S. EPA comment number 18: I agree with this U.S. EPA comment. Specifically, what degree of specificity for guidance? Did you intend for the unified guidance document to govern the re-evaluation of the upper prediction limits? If so, then you can say that explicitly. If you intended only the general principles in the guidance to apply, but not necessarily strict adherence to the unified guidance document, then you can specify that generally accepted principles will apply. This may allow some flexibility as appropriate and as dictated by the empirical results.
- 3) U.S. EPA comment number 19: This comment appears to be addressed by ARCADIS on Page 3 of 12 of their April 10th, 2012 memo, describing how the use of UPLs in this permit is appropriate for intrawell comparisons. Regarding the discussion of MW-5S as having higher levels of site constituents, this is not relevant since the methods in the permit can be used for intrawell comparisons, as indicated by ARCADIS. However, to evaluate the U.S. EPA assertion that MW-5s has elevated levels of constituents it would be necessary to consider the specific wells under consideration and both the method detection and reporting limits that were used. The detections in the background well (MW-5s) are all “j”-qualified. Typically, this qualifier means the analyte was present or detected in the samples with some level of statistical confidence, but was below the instrument calibration range and is therefore an imprecise estimate of concentration. Because these estimated concentrations in well MW-5s are so low with relatively greater imprecision or spread in the results, a more detailed comparison of the respective reporting and detection limits between wells would be needed in addition to any hypothesis tests to make an informed judgment regarding whether the concentrations were different from other wells. I did not do this as part of this review. If this is required, I would need the laboratory packages, with the laboratory qualifiers, definitions and the corresponding detection and reporting limits. If these are not available, a simpler comparison of precision between wells and non-parametric hypothesis tests could be performed to help inform whether the low levels in MW-5 differ from other select wells.

Power Curves

I computed a series of example power curves as spot check of the ARCADIS results. In each case, the resulting power curve met or exceeded the specific standard as indicated by ARCADIS. Four examples are presented below.

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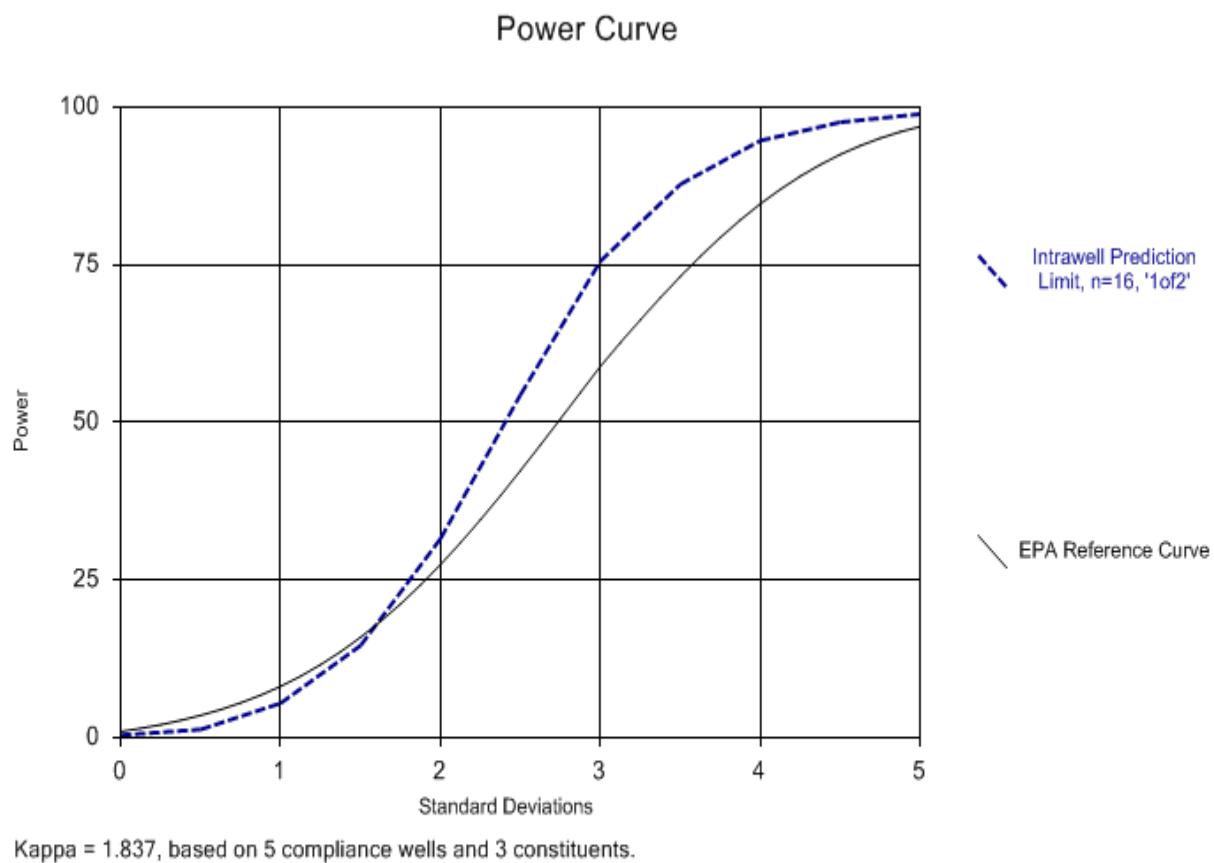


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Figure 1: MW-37S Sulfate

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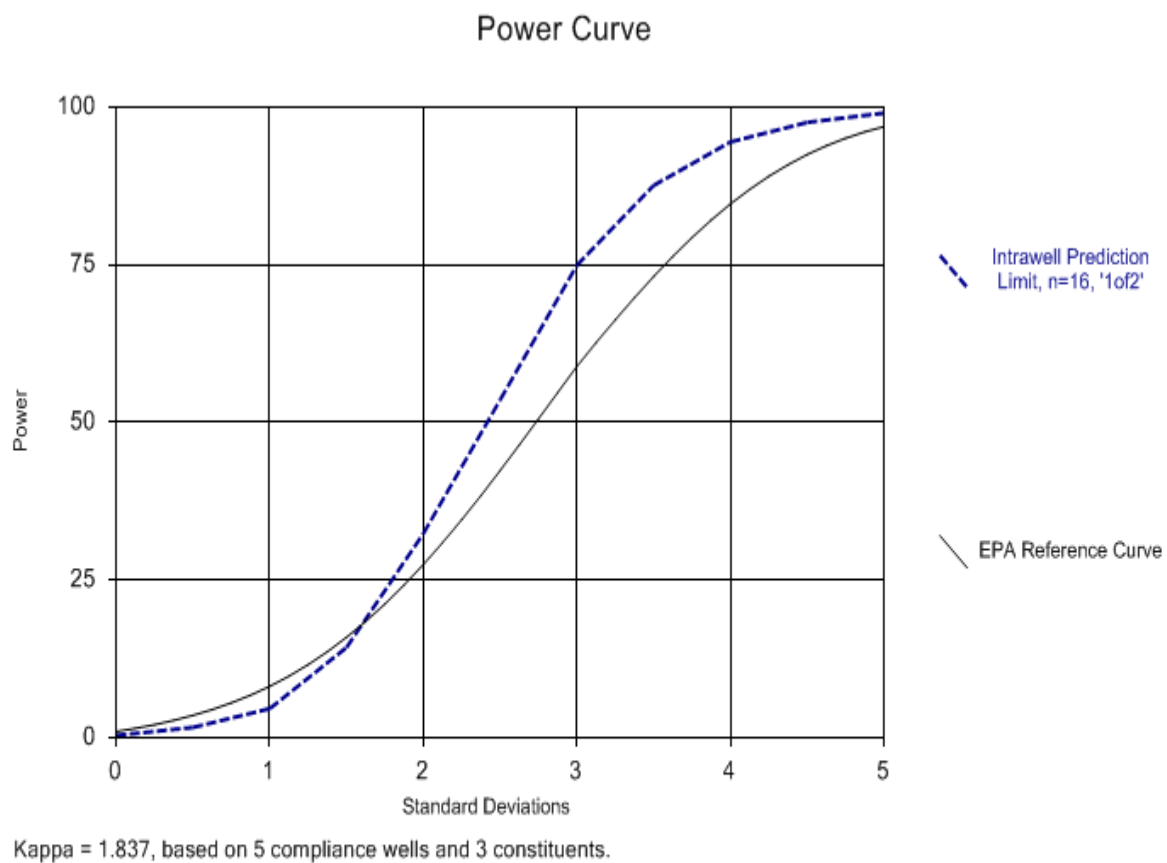


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Figure 2: MW-35S Cyanide

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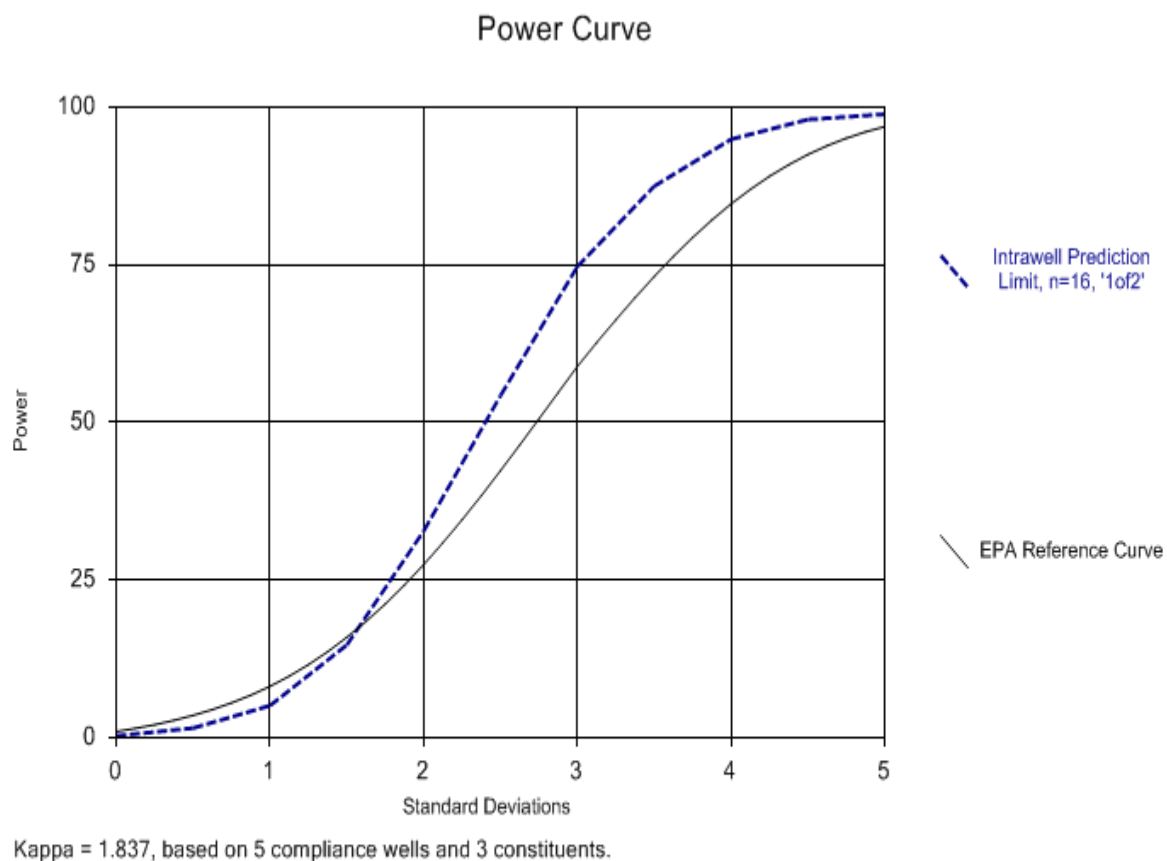


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Figure 3: MW-36S Sulfate

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Figure 4: MW-17 Cyanide

ARCADIS Update

The approach described by ARCADIS is good. I have no significant concerns with what they have done. I would request clarification for sulfate at MW-37. Why did they select the Wilson Hilferty (WH) UPL for Table 1? This is one of the higher gamma-UPLs in the group of 99% UPLs calculated by ProUCL. They had one high outlier in February 2011 that skews the distribution. It would seem based on the trend that a lower UPL would be more realistic in this case. I reproduce the UPL calculations using the data provided in the appendix.